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I.—*Geological Notes on the Northern Conkan, and a small portion of Guzerat and Kattywár.* By CHARLES LUSH, M. D.

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In a paper which recently appeared in the Journal of the Asiatic Society of Bengal by Dr. BENZA, on the Geology of the Nilgherry hills, it is remarked that “the elevation of this plateau, and probably the whole chain of the Western Ghats, of which the Nilgherries are the southern termination, happened at a period long anterior to the existence of life on our planet.”

This appears, at first sight, a bold and sweeping conclusion: but I apprehend that those who have travelled in the *Dekhan*, the *Southern Conkan*, and that part of the *Carnatic* termed with us “*Southern Maratha country*,” will not only be ready to concur in this opinion, but perhaps to extend it so far as to doubt the existence of any formation containing fossil remains in any part of Western India to the southward of *Cutch*.

In that province, it has been stated that oolite occurs. I believe, however, that no sufficient investigation has been made into this fact, to entitle us to assume the identity of such shell-stone with the recognized oolitic formations of other countries, so as to satisfy the rigorous views of a modern geologist.

There is a new era in geology. It is now in the power of any person who travels through countries where “the crust of the globe is untouched by the hammer of the geologist,” to contribute to the advancement of this, the youngest of the sciences. By avoiding

speculations, not even giving a name to that which is found,—by carefully noting the site of specimens collected, according to the directions published by the Geological Society of London,—by forwarding collections to those persons who are best capable of comparing and identifying fossil remains,—materials will gradually be formed for a geological map of India, as well as for the development of sound doctrine regarding the mode and date of deposits. Let the traveller who goes northward over the plateau of the *Dekhan*, or who follows up the coast of the *Conkan*, conclude with Dr. BENZA that the primary, the trap and the laterite rocks—nay, even the alluvial covering these, are antecedent to the existence of animal life on our planet. But, on finding in parts of the *Southern Conkan*, and especially in the island of *Bombay*, horizontal strata of sandstone containing shells, it would be well to look with more suspicion to the northward, and to be prepared to doubt the non-fossiliferous character of the rocks. The shell-stone of *Bombay* will, I hope, be investigated agreeably to modern rules, and materials furnished to those who are capable of deciding whether any, or what proportion of the shells belong to extinct species. It is easy to name this stone “coral rag,” and it would cost no labour to speculate upon its being simply a deposit actually going on at the bottom of the *Bombay* harbour; a deposit here and there brought to light in consequence of portions of the present island having been gained from the sea since the place became a settlement. This question can only be determined in one mode;—by the examination and comparison of a few hundreds of species of shells. Decide then whether all are existing, or part extinct. Leaving this important matter for the investigation of some persons at the Presidency, I proceed to copy a few notes collected in a tour through the *Northern Conkan*, part of *Guzerat*, and *Kattywár*.

The most remarkable geological feature in the *Northern Conkan* between *Bassein* and *Surat*, is the extensive degradation and partial reproduction of land at different periods. Occasionally, denuded-strata are met with, the date of which can alone be determined by the nature of their organic remains. The first place at which I remarked strata of sandstone similar to those of *Bombay*, was at *Mahim*, (*Northern Conkan*.) There is a low cliff of from ten to twelve feet in height, composed of horizontal strata from one to three or four inches in thickness. On leaving the town of *Mahim* the road passes over a tract of some extent formed of these shell strata, which after some intermediate alluvial, which conceals the nature of the subjacent formation, reappear at the coast under the fort and public bungalow of *Seergaum*.

As there has been a great destruction of land at this place, the cliff under the bungalow may be viewed with interest. It averages about 20 feet in height above the ordinary level of the tides. The upper five feet is alluvial, the lower fifteen feet consisting of horizontal strata of sandstone in different states of aggregation. Nearly at right angles with the fort of *Seergaum*, a point of land runs out towards the sea, of the same general aspect as the strata just described. This seems to have been once continuous with another portion reaching out from the coast, at a distance of about five miles to the northward. The natives state that the whole bay was once land. The destruction seems to have stopped for the present at a Mussulman burying ground, where human bones may now be seen exposed; and which the fossil seeker must be careful to distinguish from "organic remains of a former world." If after another shifting of place between sea and land, a deposit should be formed above, so as to press and solidify the sand, containing skeletons, a mistake of this kind may as easily occur here, as it did at *Guadaloupe*.

The road through *Tarapúr*, *Dannú* and *Jyebúrdí* affords many opportunities of seeing sections of these strata,—all horizontal and evidently above the trap. Trap rocks still form the gradually diminishing hills inland, being the continuation of the Western Ghat range. Where the trap is exposed, as in some of the numerous creeks, it presents the same weather and water-worn appearance as in the rivers of the *Dekhan*.

It has been assumed (seemingly by Professor JAMESON\*) in a late summary of the geology of India, that the trap formation reaches to the *Nerbudda*. I therefore presume that there exists no written evidence to the contrary. This mistake has probably arisen from rolled pebbles of trap having been seen in the bed of the *Nerbudda*, opposite the *Kabbír Bar* a few miles above *Broach*; or it may have been a simple conjecture. The fact is, that the trap ceases on the coast between *Balsár* and *Gandávie*. The last hills being those called *Dúngrí*, a low range near the village so called, scarcely more than 100 feet in height and composed of porphyritic trap. The well known hill fort of *Punera*, near the town of *Balda Párí*, is the last trap hill of any height in this direction. At *Gandávie* are strata of clay, containing *kankar*, and from this point we take leave of trap, as well as of shell sandstone: *kankar*, and clay of various forms now present themselves in the only sections seen from *Gandávie* to *Surat*. The form and situation of the *kankar* at *Dámus* demands future notice. The point of geological interest about *Surat* is the constant destruction and partial

\* Vide British India, vol. iii. Art. Geology.

renovation of land. But especially we note here destruction and *degradation* by freshes and spring tides, where the water is all powerful, and there are no "antagonist forces," such as are imagined by those who are inclined to slight actual causes, and to controvert the principles so ably developed by Mr. LYELL. I cannot avoid here remarking, as it is a point so à propos to the country under consideration, that a strange assumption has gone forth with regard to the powers and magnitude of tropical vegetation and its agency on the crust of the globe; as if it were a *general* law of nature that the nearer we approach to the equator, the thicker the vegetation. So that tropical vegetation must have essentially a greater power of resistance to the destruction of land than extra-tropical. Such a position is manifestly untenable on the old continent, whatever ground there may be for the opinion in the *West Indies* and *South America*. In *Guzerat* and in the *Dekhan* bareness of natural vegetation is the prevailing character; while even in *Malabar*, where the most rank vegetation exists, I have been shewn such devastation from the sea alone, that I am inclined to think that no "antagonist power" of vegetation can be worth considering. An eminent geologist\*, advertizing to the doctrines of Mr. LYELL, asks, "Are there no antagonist powers in nature to oppose these mighty ravages? no conservative principles to meet this destructive agency? The single operation of vegetation is a vast counterpoise to all." (!)

Should we interrogate nature in *Guzerat*, especially about the *Tapti* and *Nerbudda*, we shall find that the conservative principles of vegetation stand no chance against the destructive agency of water.

On the plateau of the *Dekhan*, degradation can only be slightly repaired in one place, by the operation of degradation from a higher level and subsequent deposit below. At the level of the sea in the *Northern Conkan* and in *Guzerat* the rains carry away vegetable mould and vegetation with it. The denuded tracts support no vegetation capable of protecting the land on which it grows from farther loss. The tides with the small portion of sediment they deposit, bring no contribution to vegetable soil. Should they throw up a shoal between the periodical rains, the next fresh would certainly carry it away. The "antagonist powers" are here freshes and tides, but they both tend to the destruction of vegetation, and to throw insuperable obstacles in the way of its renewal.

Proceeding from *Surat* through *Oolpar* to the *Kim* river, nothing but black cotton soil occurs until you cross the *Kim*, at the village

\* Professor SEDGWICK.

of *Kudrama*,—there sandstone and conglomerate are exposed at the surface.

*River Kim, section of the right bank at Sawal.*

No. 1. Alluvial containing irregularly imbedded masses of conglomerate, 6 feet.

No. 2. Three feet of horizontal strata of sandstone from one to two inches in thickness.

No. 3. Five feet of sandstone varying in hardness.

No. 4. Bed of the river, consisting of coarse conglomerate, coarser than the imbedded masses No. 1.

There is no sign of stone of any kind on the left *Oolpar* bank of the *Kim*. This formation of conglomerate and sandstones, is only known in this tract of country to extend from the village of *Koba*, through *Elao* and *Sawal* to *Súnú*.

There is reason to believe that the same rocks form the *Raj-pípla* range of hills and portions of the peninsula of *Kattywár*. The central ridge of *Kattywár*, of which the celebrated hill of *Polítana* forms a part, is undoubtedly trap, the usual varieties of which are met with at *Baunagar*. The most remarkable part of this formation (of sandstone, &c.) is the cornelian deposit at the celebrated mines near the *Nerbudda* at *Rattanpúr*. These mines were described by Mr. COPLAND, Trans. Lit. Soc. Bombay. The general account is correct, but Mr. C. is in error with respect to the appearance of igneous action upon the hill of *Bawa Gorea*, which consists of sandstone and conglomerate rocks,—but not a trace of trap.

Leaving the town of *Okleysir* on the south bank of the *Nerbudda*\*, on the road to the cornelian mines through *Sarapúr*, *Clareville* and *Rappalsúri*, the flat black cotton soil plain gradually begins to undulate; and in a nullah near the new village of *Clareville* I saw the first appearance of stone (kankar of course excepted) even in fragments since crossing the *Kim*. The masses were sandstone and conglomerate. The soil now mixed with sand here gradually loses its tenacity and fitness for cotton cultivation. At length, under *Rattanpúr*, the place where the cornelians are brought to undergo the process of baking, a clear section occurs on the bank of a nullah or small river of rather saltish water opposite the village, shewing under a superficial stratum of alluvial, 5 feet thick strata of sandstone, 25 feet deep, inclined at an angle of about 70°.

\* From *Hansót* to *Sugód* (and I presume farther) may be seen a deserted bed of the *Nerbudda*, the bank varying in height, consisting of clay with regular horizontal deposits of kankar. The large tank at *Sujód* is evidently a portion of the old bed of the river.

The direction of these highly inclined strata is N. E. and S. W., corresponding to similar strata on the opposite or *Rattanpúr* side of the nullah,—dip N. W. The extent of this section, as far as it is well exposed, is about 40 feet of the bank.

The banks of the nullah above *Rattanpúr* shew irregularly stratified masses of a compact earthy rock with dendritic figuring; also a conglomerate containing some appearances, though not quite unequivocal, of fossil bone. These are not accompanied, as far as I could observe, by fossil shells, and it is only from having since found undoubted fossil matter in similar deposits that I have thought them worth forwarding for comparison.

This nullah contains rolled masses of jaspers, various agates, &c. &c., but no trace of a rolled piece of any variety of trap as may be seen in the bed of the *Nerbudda* near the *Kabbír Bar*.

In the village of *Rattanpúr* the cornelians are collected and exposed to the air for a month or two. If on being chipped they are found likely to be worth working, they are put into earthen pots (the usual water pots) with some earth and sand, and exposed to a fire for a day and night. At the end of the hot season they are sent down the *Nerbudda* by way of *Broach* to *Cambay*, to be cut and polished.

The cornelian mines are about four miles from *Rattanpúr* in a thick jungle. The people who work them return every night to *Rattanpúr*, there being no habitations near the mines. From the principal spot now working the following small hamlets are thus distanced.

*Damláe*, one mile south.

*Ahmod*, one and half mile north.

*Padwana*, 3 miles south-east.

To the eastward all is jungle.

The stones are said to be found over a space of about four miles.

The formation containing cornelians is a deep bed of red gravel, very like the London gravel: in it are found pebbles of various form and size, of the different species or varieties of chalcedony,—irregularly imbedded, and not in layers like flints in chalk.

The mines are usually sunk to about thirty feet, but on digging to sixty feet neither hard rock nor water is met with. I therefore conclude that this is a partial deposit entirely above the sandstone-conglomerate formation, which is denuded at the surface of the nullah before mentioned, which forms also the *Bawa Gorea* hill, and I believe the general range of the *Raj-píplas*.

As far as I could observe, there is no sign of organic remains in these gravel beds,—but every thing hereabouts should be examined carefully, as the building stones in several of the villages contain

fossil shells; so that if the people could trace them to the quarries, it might lead to some interesting discoveries in the *Raj-pípla* range.

I saw no sign of this formation from *Broach* to the *Maihi* river, opposite *Cambay*, nor on the *Tankeria Bunder* side of the gulf.

The next point at which I found conglomerate rock was at *Gogo* in *Kattywár*, where masses of rock containing shells are dug out from the beach, the upper portions having been carried away by the encroachments of the sea.

This formation will, I hope, be soon traced up the south-eastern to the western coast of *Kattywár*. I before observed that the rocks at *Baunagar* are trap. Now these conglomerates appear to contain fragments of a great variety of mountain rocks, always excepting trap. This circumstance affords suspicion that the trap was thrown up subsequently to the deposit of the conglomerates. I say merely suspicion, as I know of no evidence of upheaving, nor the nature of the strata at the points of junction. These, between *Gogo* and *Baunagal*, are either obliterated by extensive degradation, or concealed by deposits of mud.

The island of *Perim* in the gulf of *Cambay*, afforded me a better opportunity of examining the conglomerate than the denuded beach of *Gogo*.

*Perim* is about three miles in circumference. About half the island, proceeding round the western side towards the southernmost point, consists of strata of conglomerate rock much acted upon, but forming cliffs in several parts to a height of about 30 feet above the sea, the upper strata being of compact sandstone,—all perfectly horizontal. The conglomerate contains shells and other fossils, some undoubted bones, &c. which have been forwarded for identification to *Calcutta*.

Fine sand,—partly from the decomposition of these rocks, but chiefly, perhaps, thrown up by the tides from the opposite coast,—appears to have been blown by the south-west monsoon, so as to form *dunes* of very singular aspect, mostly rounded at the top. In one place a sand hill has a quadrangular platform-like summit. These sand-mounts seem to have formed a barrier to the farther encroachments of the sea. There is a valley to the eastern side of the island partly in turf, and some part cultivated open to the sea, where one may walk with a firm footing, while the sandy *dunes* of the higher level give way in every direction.

Proceeding from the south point towards the eastward (the open valley), layers of kankar are met with *below* the sandstone,—beyond this is a low cliff of sand,—the valley completing the circuit.

In the hope that some\* of our members stationed in *Guzerat* will carry on the investigation of the fossils, not only of *Perim*, but of other parts of the formation in *Kattywár*, I have hastened to lay before them this imperfect sketch, without waiting for a report on the *nature of the fossils* found, or presuming myself to offer any opinion, or to draw a conclusion on that part of the subject.

II.—*Note on Mastodons of the Sewaliks.* By Capt. P. T. CAUTLEY,  
Superintendent of the Doab Canal. Pl. XL.

In the present state of the researches into the fossil remains of the Sewaliks, it will be interesting to note any discovery of peculiar interest, without entering upon a description in detail. Such a description may, with propriety, be reserved, until the possession of a more perfect and a more numerous collection of remains enables us to enter upon the description with greater confidence: whilst, in the mean time, to those who are interested in the study, the periodical announcement of progress made in our operations, cannot be devoid of interest; under this idea I did myself the pleasure of forwarding to your Society the note on the dentition of the *Mastodon Angustidens* (variety of), and now send you one on a skull of another variety of *Mastodon* which has been lately received. The sketches are drawn on transfer paper, and will, I hope, be intelligible.

Fig. 1 and 2, are representations of the fossil skull—Fig. 1 being the front, and Fig. 2, the profile or side view. Fig. 3 and 4, are similar outlines of the existing elephant, on a scale of one-eighth on linear measurement.

The fossil is exceedingly perfect in some respects. The left orbit and maxillaries are as sharp and well defined as in the recent skull; the frontal and nasals are tolerably perfect, the specimen is fractured obliquely, removing the temporal swellings and diploe of the cranium, together with the occipital condyles and foramen magnum; the curve of the occipital on its external surface is however retained, and although sutures are altogether wanting, and the alveoli of the tusks are mutilated, the specimen may be considered as sufficient to give a perfect idea of the form of skull; and, as a form perfectly unique amongst the proboscidean pachydermata, will be looked upon with satisfaction by all those who take interest in the additions that have of late years been so rapidly made to palæontology, and the catalogue of animals now no longer existing on the globe. The present skull derives additional interest from its being so different from the only